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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 09/785,944 | 02/16/2001 | Martin E. Fernann | IMRAA.015C1 | 7227 |

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EXAMINER

FLORES RUIZ, DELMA R

| ART UNIT | PAPER NUMBER |
|----------|--------------|
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2828

DATE MAILED: 11/06/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/785,944

Applicant(s)

FERMANN, MARTIN E.

Examiner

Delma R. Flores Ruiz

Art Unit

2828

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07/26/2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-50, 55 - 58 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 - 19, 22 - 50, and 55- 58 is/are rejected.
- 7) ☐ Claim(s) 20 and 21 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.



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Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1 – 19, 22 – 50, and 55 - 58 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fermann et al (5,627,848) in view of Harter et al. (6,034,975).

Regarding claims 1 – 19, 22 – 50, and 55- 58, Fermann et al disclose a laser for generating ultra-short optical pulses (Fig. 1, 4 – 8), comprising: a cavity which repeatedly passes light energy along a cavity axis; a length of multi-mode optical fiber (see Fig. 1 Character 101) doped with a gain medium and positioned along said cavity axis; a pump (see Fig. 1 Character 103) for exciting said gain medium, the multi-mode optical fiber doped with a gain medium and positioned along said cavity axis (see Fig. 1 Character 104) . A laser for generating ultra-short optical pulses wherein said mode-locking mechanism comprises a passive mode-locking element (Fig. 1, and Column 3, lines 13 – 26). A laser for generating ultra-short optical pulses wherein said

passive mode locking element comprises a saturable absorber (abstract, Column 3, lines 13 – 26, Column 5, lines 61 – 63). A laser for generating ultra-short optical pulses wherein said saturable absorber comprises InGaAsP (Column 5, lines 61 – 63). A power limiter for protecting said saturable absorber (Figs. 1, 4, 6 and 8, character 118). A laser for generating ultra-short optical pulses wherein said optical guide comprises a single-mode mode-filter (see Fig. 5 Character 201) fiber on said cavity axis (Column 7, lines 28 – 43 and Column 8, lines 11 – 22). A laser for generating ultra-short optical pulses, additionally comprising a polarization beam splitter (see Fig. 1 Character 117, abstract, Column 5, lines 10 – 23) for outputting said ultra-short optical pulses from said laser. A laser for generating ultra-short optical pulses, wherein said cavity comprises a pair of reflectors (see Fig. 1 Character 102, 106) at its opposite ends. A laser for generating ultra-short optical pulses, wherein one of said pair of reflectors (see Fig. 1, 4, 5, Character 302, 102, 106, Column 7, lines 55 – 67 and Column 8, lines 1 – 22) is partially reflecting and provides the output for said cavity. A laser for generating ultra-short optical pulses, wherein said mode locking mechanism comprises a saturable absorber, and wherein one of said reflectors is formed on a surface of said saturable absorber (Column 7, lines 55 – 67 and Column 8, lines 1 – 59). A laser for generating ultra-short optical pulses, additionally comprising a linear phase drift compensator on said cavity axis (Fig. 1, 4 – 8 and Column 5, lines 10 – 23). A laser for generating ultra-short optical pulses wherein said linear phase drift compensator comprises a Faraday rotator (113 or 114, Fig. 8, and Column 1, lines 49 – 56 and Column 5, lines 10

– 23). A laser for generating ultra-short optical pulses, wherein said linear phase drift compensator comprises a pair of Faraday rotators(113, 114, Fig. 8, and Column 1, lines 49 – 56 and Column 5, lines 10 – 23). 25. A laser for generating ultra-short optical pulses additionally comprising a linear polarization transformer on said cavity axis (see Fig. 1, Character 117, abstract, Column 5, lines 10 – 23 and Column 7, lines 55 – 67).

A laser for generating ultra-short optical pulses, wherein said linear polarization transformer comprises a wave plate (Fig. 8 Column 5, lines 10 – 23 and Column 6, lines 7 – 16). A laser for generating ultra-short optical pulses, wherein said mode locking mechanism comprises an active mode-locking element (Fig. 6). A laser for generating ultra-short optical pulses, wherein said active mode locking element comprises an optical amplitude modulator (301 or 302 in Fig. 6, Column 7, lines 44 – 54 and Column 8, lines 6 – 22). A laser for generating ultra-short optical pulses, wherein said active mode locking element comprises an optical frequency modulator (301 or 302 in Fig. 6 and Column 7, lines 44 – 54). A laser for generating ultra-short optical pulses, wherein said ultra-short optical pulses preferentially in the fundamental mode of said multi-mode optical fiber have a pulse width below 500 psec (Column 2, lines 51 – 67).

A laser for generating ultra-short optical pulses, additionally comprising an environmental stabilizer on said cavity axis to assure that said cavity remains environmentally stable (Column 7, lines 55 – 67 and Column 8, lines 1 – 22). 32. A laser for generating ultra-short optical pulses, wherein said environmental stabilizer comprises a Faraday rotator (113 or 114, Fig. 8, and Column 1, lines 49 – 56 and

Column 5, lines 10 – 23). A laser for generating ultra-short optical pulses, wherein said environmental stabilizer comprises a pair of Faraday rotators (113 or 114, Fig. 8, and Column 1, lines 49 – 56 and Column 5, lines 10 – 23). A laser for generating ultra-short optical pulses, wherein said optical guide comprises an optical fiber doped with an amplifying medium to provide gain guiding (Column 8, lines 1 – 59). A laser for generating ultra-short optical pulses, wherein said amplifying medium is concentrated centrally within a fraction of the core diameter of said optical fiber (Column 4, lines 19 – 40). A laser for generating ultra-short optical pulses, wherein said optical guide comprises a single-mode optical fiber on said cavity axis (Fig. 5, 201 and Column 7, lines 20 – 43). 40. A laser for generating ultra-short optical pulses, wherein said cavity additionally comprises a positive dispersion element (Fig. 5, and Column 7, lines 20 – 43). A laser for generating ultra-short optical pulses, wherein said positive dispersion element comprises a length of single-mode positive dispersion fiber positioned along said cavity axis (Fig. 5, and Column 7, lines 20 – 43). A laser for generating ultra-short optical pulses, additionally comprising an output coupler for limiting the light energy at said single-mode positive dispersion fiber to less than 10% of the peak power in said cavity (Fig. 5, and Column 7, lines 20 – 43). A laser for generating ultra-short optical pulses, wherein said multi-mode fiber includes a core, and wherein said gain medium in said multi-mode optical fiber is concentrated centrally within the core of said multi-mode fiber (Fig. 1 and , 4 – 8, and Column 9, lines 19-24). A laser for generating ultra-short optical pulses, wherein said multi-mode optical fiber is polarization-maintaining (Column

5, lines 10 23, and Column 8, lines 32 – 49). A laser for generating ultra-short optical pulses, wherein said cavity additionally comprises a fiber grating (see Fig. 1 Character 105) written onto said multi-mode fiber, said grating (see Fig. 1 Character 105) primarily reflecting the fundamental mode of said multi-mode fiber. A mode-locked laser for generating high power ultra-short optical pulses (Fig. 1, 4 – 8), comprising: a multi-mode optical fiber (101) doped with gain material for amplifying optical energy; means for pumping (103) said optical fiber; and means for confining the optical energy amplified by said multi-mode optical fiber to substantially the fundamental mode of said multi-mode optical fiber .

Fermann discloses the claimed invention except for an optical guide positioned on cavity axis which confines the light amplified by said multi-mode optical fiber to preferentially the fundamental mode of said multi-mode fiber, the single mode filter is fusion spliced onto one end of said multi-mode optical fiber, the multi-mode fiber and multi mode filter fiber are tapered at said fusion spliced, and the pump is coupled to said multi-mode fiber along said cavity axis. It would have been obvious at the time of applicant's invention, to combine Harter et al of teaching a multi-mode optical fiber doped with a gain medium and positioned along said cavity axis with a laser for generating ultra-short optical pulse because the stretched optical pulses are then transmitted through a fiber which delivers the optical pulses to a desired location. Single-mode fiber is preferred for many applications, since multi-mode fiber can present the complexity of the different modes presenting differing propagation lengths. However,

multi-mode fiber can be used to advantage in a number of situations. Multi-mode fiber has a larger effective mode-field diameter, and accordingly a higher peak power delivery capability. One particularly attractive case for using multimode fiber in delivery (using either passive or active (amplifier) fiber) is the case when the lowest order mode is excited in a multimode fiber. This takes advantage of the larger effective mode-field diameter, allowing for higher peak power delivery due to lower non-linear effect threshold, while avoiding the dispersion problem from the transmission of several modes through the fiber. And it would have been obvious at the time of applicant's invention, of teaching a laser for generating ultra-short optical pulses wherein said single-mode mode-filter fiber is fusion spliced onto one end of said multi-mode optical fiber, a multi-mode fiber is tapered at said fusion splice, the pump is coupled to said multi-mode fiber along said cavity axis, and v-groove on the multi-mode optical fiber for coupling said pump to said multi-mode fiber because are very well known in the art and hence would have been obvious to one of ordinary skill in the art at the time the invention was made to apply these teachings to the claimed apparatus. The mode locked laser output from an optical cavity having a gain medium, in which the method comprises amplifying an optical signal in the gain medium to produce an amplified optical signal, directing the amplified optical signal through a saturable absorber to produce a mode locked optical signal, amplifying the mode locked optical signal in the

gain medium to produce an amplified mode locked optical signal, and outcoupling a fraction of the amplified mode locked optical signal with a polarizing element. An optical cavity for a short pulse mode locked fiber laser, in which the cavity comprises first and second reflectors, which are each at least partially reflecting and respectively define first and second ends of the cavity. The cavity further comprises a fiber including a gain medium disposed between the first and second cavity ends, as well as a pump signal injector connected to introduce pump light into the fiber toward the first cavity end, in which the pump light excites the gain medium to produce a laser signal. The cavity also comprises a saturable absorber proximate the first cavity end for inducing mode locking of the laser signal, and an output coupler proximate the second cavity end for outcoupling a portion of the laser signal in the form of short output pulses.

Allowable Subject Matter

Claims 20, and 21 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 20 – 21 have been allowed over the prior art because they fail to teach a laser for generating ultra-short optical pulses wherein said mode locking mechanism comprises a saturable absorber is formed on a surface of said power limiter opposite said one of said reflectors.

Response to Arguments

Applicant's arguments with respect to claims 1 – 50, and 55 - 58 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Delma R. Flores Ruiz whose telephone number is (703) 308-6238. The examiner can normally be reached on M - F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Ip can be reached on (703) 308-3098. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 306-3431.



Delma R. Flores Ruiz
Examiner
Art Unit 2828



Paul Ip
Supervisor Patent Examiner
Art Unit 2828

DRFR/PI
October 23, 2002